CLAIMS:

1. A method of reducing the water permeability of a well bore, comprising:

introducing into the wellbore a wellbore treating fluid to separate a first fluid from a second fluid and to displace the first fluid from the wellbore in advance of the second fluid,

wherein the wellbore treating fluid comprises a water soluble relative permeability modifier, and

wherein the water soluble relative permeability modifier comprises a hydrophobically modified water soluble polymer;

thereby reducing the water permeability of the well bore.

2. The method of claim 1, wherein the hydrophobically modified water soluble polymer is a reaction product of a hydrophilic reactive polymer and a hydrophobic compound.

3. The method of claim 2, wherein the hydrophilic reactive polymer comprises a reactive amino group.

4. The method of claim 3, wherein the reactive amino group is located in the polymer backbone or is a pendant group.

5. The method of claim 2, wherein the hydrophilic reactive polymer comprises a dialkyl amino pendant group.

6. The method of claim 2, wherein the hydrophilic reactive polymer comprises a dimethyl amino pendant group.

7. The method of claim 2, wherein the hydrophilic reactive polymer is a product of a polymerization reaction in which at least one monomer is selected from the group consisting of dimethylaminoethyl methacrylate and dimethylaminopropyl methacrylamide.

8. The method of claim 2, wherein the hydrophilic reactive polymer is a homo-, co- or terpolymer.

9. The method of claim 2, wherein the hydrophilic reactive polymer is selected from the group consisting of polyethyleneimine, polyvinylamine, poly(vinylamine/vinyl alcohol), chitosan and polylysine.

10. The method of claim 2, wherein the hydrophilic reactive polymer comprises an alkyl acrylate polymer.

11. The method of claim 10, wherein the alkyl acrylate polymer is selected from the group consisting of polydimethylaminoethyl methacrylate, polydimethylaminopropyl methacrylamide, poly(acrylamide/dimethylaminoethyl methacrylate), poly(acrylamide/dimethylaminopropyl methacrylamide) and poly (acrylic acid/dimethylaminoethyl methacrylate).

12. The method of claim 11, wherein the alkyl acrylate polymer is selected from the group consisting of polydimethylaminoethyl methacrylate and polydimethylaminopropyl methacrylamide.

13. The method of claim 2, wherein the hydrophobic compound comprises an alkyl halide.

14. The method of claim 13, wherein the alkyl halide comprises an alkyl chain of from about 4 to about 30 carbon atoms.

15. The method of claim 13, wherein the hydrophobic compound comprises cetyl bromide.

16. The method of claim 1, wherein the hydrophobically modified water soluble polymer is a reaction product of a hydrophilic monomer and a hydrophobically modified hydrophilic monomer.

17. The method of claim 16, wherein the hydrophilic monomer is selected from the group consisting of acrylamide, 2-acrylamido-2-methyl propane sulfonic acid, N,N-dimethylacrylamide, vinyl pyrrolidone, dimethylaminoethyl methacrylate, acrylic acid, dimethylaminopropylmethacrylamide, vinyl amine, trimethylammoniumethyl methacrylate chloride, methacrylamide and hydroxyethyl acrylate.

18. The method of claim 16, wherein the hydrophilic monomer is selected from the group consisting of acrylamide, 2-acrylamido-2-methyl propane sulfonic acid, acrylic acid, dimethylaminoethyl methacrylate, dimethylaminopropyl methacrylamide and vinyl pyrrolidone.

19. The method of claim 16, wherein the hydrophobically modified hydrophilic monomer is selected from the group consisting of alkyl acrylates, alkyl methacrylates, alkyl acrylamides and alkyl methacrylamides wherein the alkyl radicals have from about 4 to about 22 carbon atoms; alkyl dimethylammoniumethyl methacrylate bromide, alkyl dimethylammoniumethyl methacrylate chloride and alkyl dimethylammoniumethyl methacrylate iodide wherein the alkyl radicals have from about 4 to about 22 carbon atoms; and alkyl dimethylammoniumpropyl methacrylamide bromide, alkyl dimethylammoniumpropyl methacrylamide chloride and alkyl dimethylammoniumpropyl methacrylamide iodide wherein the alkyl groups have from about 4 to about 22 carbon atoms.

20. The method of claim 19, wherein the hydrophobically modified hydrophilic monomer is selected from the group consisting of octadecyldimethylammoniumethyl methacrylate bromide, hexadecyldimethylammoniumethyl methacrylate bromide, hexadecyldimethylammoniumpropyl methacrylamide bromide, 2-ethylhexyl methacrylate and hexadecyl methacrylamide.

21. The method of claim 16, wherein the hydrophobically modified water soluble polymer has a molecular weight in the range of from about 250,000 to about 3,000,000.

22. The method of claim 16, wherein the hydrophilic monomer and the hydrophobically modified hydrophilic monomer are present in the hydrophobically modified water soluble polymer at a mole ratio of from about 99.98:0.02 to about 90:10.

23. The method of claim 16, wherein the hydrophobically modified water soluble polymer is selected from the group consisting of acrylamide/octadecyldimethylammoniumethyl methacrylate bromide copolymer, dimethylaminoethyl methacrylate/hexadecyldimethylammoniumethyl methacrylate bromide copolymer, dimethylaminoethyl methacrylate/vinyl pyrrolidone/hexadecyldimethylammoniumethyl methacrylate bromide terpolymer and acrylamide/2-acrylamido-2-methyl propane sulfonic acid/2-ethylhexyl methacrylate terpolymer.

24. The method of claim 23, wherein the hydrophobically modified water soluble polymer comprises a dimethylaminoethyl methacrylate/hexadecyldimethylammoniumethyl methacrylate bromide copolymer having a mole ratio of hydrophilic monomer to hydrophobically modified hydrophilic monomer of 95:5.

25. A method of reducing the water permeability of a well bore, comprising:

introducing into the wellbore a wellbore treating fluid to separate a first fluid from a second fluid and to displace the first fluid from the wellbore in advance of the second fluid,

wherein the wellbore treating fluid comprises a water soluble relative permeability modifier and the water soluble relative permeability modifier comprises a hydrophilically modified water soluble polymer,

wherein the hydrophilically modified water soluble polymer is a reaction product of a hydrophilic reactive polymer and a hydrophilic compound, and

wherein the hydrophilic reactive polymer comprises an alkyl acrylate polymer selected from the group consisting of polydimethylaminopropyl methacrylamide, poly(acrylamide/dimethylaminoethyl methacrylate), poly(acrylamide/dimethylaminopropyl methacrylamide) and poly (acrylic acid/dimethylaminoethyl methacrylate),

thereby reducing the water permeability of the well bore.

26. The method of claim 25, wherein the alkyl acrylate polymer is polydimethylaminopropyl methacrylamide.

27. The method of claim 25, wherein the hydrophilic reactive polymer comprises a reactive amino group.

28. The method of claim 27, wherein the reactive amino group is located in the polymer backbone or is a pendant group.

29. The method of claim 25, wherein the hydrophilic reactive polymer comprises a dialkyl amino pendant group.

30. The method of claim 25, wherein the hydrophilic reactive polymer comprises a dimethyl amino pendant group.

31. The method of claim 25, wherein the hydrophilic reactive polymer is a product of a polymerization reaction in which at least one monomer is selected from the group consisting of dimethylaminoethyl methacrylate and dimethylaminopropyl methacrylamide.

32. The method of claim 25, wherein the hydrophilic reactive polymer is a homo-, co- or terpolymer.

33. The method of claim 25, wherein the hydrophilically modified water soluble polymer comprises a polymer having a molecular weight in the range of from about 250,000 to about 3,000,000.

34. A method of reducing the water permeability of a well bore, comprising:

introducing into the wellbore a wellbore treating fluid to separate a first fluid from a second fluid and to displace the first fluid from the wellbore in advance of the second fluid,

wherein the wellbore treating fluid comprises a water soluble relative permeability modifier and the water soluble relative permeability modifier comprises a hydrophilically modified water soluble polymer,

wherein the hydrophilically modified water soluble polymer is a reaction product of a hydrophilic reactive polymer and a hydrophilic compound, and

wherein the hydrophilic reactive polymer is selected from the group consisting of polyethyleneimine, polyvinylamine, poly(vinylamine/vinyl alcohol), chitosan and polylysine,

thereby reducing the water permeability of the well bore.

35. A method of reducing the water permeability of a well bore, comprising:

introducing into the wellbore a wellbore treating fluid to separate a first fluid from a second fluid and to displace the first fluid from the wellbore in advance of the second fluid,

wherein the wellbore treating fluid comprises a water soluble relative permeability modifier and the water soluble relative permeability modifier comprises a hydrophilically modified water soluble polymer,

wherein the hydrophilically modified water soluble polymer is a reaction product of a hydrophilic reactive polymer and a hydrophilic compound, and

wherein the hydrophilic reactive polymer is a reaction product of a hydrophilic monomer copolymerized with monomers containing reactive amino groups,

thereby reducing the water permeability of the well bore.

36. The method of claim 35, wherein the hydrophilic monomer is selected from the group consisting of acrylamide, 2-acrylamido-2-methyl propane sulfonic acid, N,N-dimethylacrylamide, vinyl pyrrolidone, acrylic acid, trimethylammoniumethyl methacrylate chloride, methacrylamide and hydroxyethyl acrylate.

37. The method of claim 36, wherein the hydrophilic monomer is selected from the group consisting of acrylamide, 2-acrylamido-2-methyl propane sulfonic acid, acrylic acid and vinyl pyrrolidone.

38. A method of reducing the water permeability of a well bore, comprising:

introducing into the wellbore a wellbore treating fluid to separate a first fluid from a second fluid and to displace the first fluid from the wellbore in advance of the second fluid,

wherein the wellbore treating fluid comprises a water soluble relative permeability modifier and the water soluble relative permeability modifier comprises a hydrophilically modified water soluble polymer,

wherein the hydrophilically modified water soluble polymer is a reaction product of a hydrophilic reactive polymer and a hydrophilic compound, and

wherein the hydrophilic compound is selected from the group consisting of halogen containing polyethers,

thereby reducing the water permeability of the well bore.

39. The method of claim 38, wherein the polyether is selected from the group consisting of polyethylene oxide, polypropylene oxide, polybutylene oxide, and mixtures thereof.

40. The method of claim 38, wherein the halogen containing polyether comprises an epichlorohydrin terminated polyethyleneoxide methyl ether.

41. The method of claim 38, wherein the weight ratio of the hydrophilic reactive polymer to the halogen containing polyether is in the range of from about 1:1 to about 10:1.

42. A method of reducing the water permeability of a well bore, comprising:

introducing into the wellbore a wellbore treating fluid to separate a first fluid from a second fluid and to displace the first fluid from the wellbore in advance of the second fluid,

wherein the wellbore treating fluid comprises a water soluble relative permeability modifier and the water soluble relative permeability modifier comprises a hydrophilically modified water soluble polymer,

wherein the hydrophilically modified water soluble polymer is a reaction product of a hydrophilic reactive polymer and a hydrophilic compound, and

wherein the hydrophilically modified water soluble polymer is selected from the group consisting of the reaction product of polydimethylaminoethyl methacrylate with epichlorohydrin terminated polyethyleneoxide methyl ether, the reaction product of poly(acrylamide/dimethylaminoethyl methacrylate) with epichlorohydrin terminated polyethyleneoxide methyl ether, the reaction product of polydimethylaminopropyl methacrylamide with epichlorohydrin terminated polyethyleneoxide methyl ether, and the reaction product of poly(acrylamide/dimethylaminopropyl methacrylamide) with epichlorohydrin terminated polyethyleneoxide methyl ether,

thereby reducing the water permeability of the well bore.

43. The method of claim 42, wherein the hydrophilically modified water soluble polymer comprises a polydimethylaminoethyl methacrylate epichlorohydrin terminated polyethyleneoxide methyl ether reaction product having a mole ratio of polydimethylaminoethyl methacrylate to epichlorohydrin terminated polyethyleneoxide methyl ether of 3:1.

44. A method of reducing the water permeability of a well bore, comprising:

introducing into the wellbore an aqueous well treatment fluid comprising a water soluble relative permeability modifier,

wherein the water soluble relative permeability modifier comprises a hydrophilically modified water soluble polymer,

wherein the hydrophilically modified water soluble polymer is a reaction product of a hydrophilic reactive polymer and a hydrophilic compound, and

wherein the hydrophilic reactive polymer comprises an alkyl acrylate polymer selected from the group consisting of polydimethylaminopropyl methacrylamide,

poly(acrylamide/dimethylaminoethyl methacrylate), poly(acrylamide/dimethylaminopropyl methacrylamide) and poly (acrylic acid/dimethylaminoethyl methacrylate),

thereby reducing the water permeability of the well bore.

45. The method of claim 44, wherein the alkyl acrylate polymer is polydimethylaminopropyl methacrylamide.

46. A method of reducing the water permeability of a well bore, comprising:

introducing into the wellbore an aqueous well treatment fluid comprising a water soluble relative permeability modifier,

wherein the water soluble relative permeability modifier comprises a hydrophilically modified water soluble polymer,

wherein the hydrophilically modified water soluble polymer is a reaction product of a hydrophilic reactive polymer and a hydrophilic compound, and

wherein the hydrophilic reactive polymer is selected from the group consisting of polyethyleneimine, polyvinylamine, poly(vinylamine/vinyl alcohol), chitosan and polylysine,

thereby reducing the water permeability of the well bore.

47. A method of reducing the water permeability of a well bore, comprising:

introducing into the wellbore an aqueous well treatment fluid comprising a water soluble relative permeability modifier,

wherein the water soluble relative permeability modifier comprises a hydrophilically modified water soluble polymer,

wherein the hydrophilically modified water soluble polymer is a reaction product of a hydrophilic reactive polymer and a hydrophilic compound, and

wherein the hydrophilic compound is selected from the group consisting of halogen containing polyethers,

thereby reducing the water permeability of the well bore.

48. The method of claim 47, wherein the polyether is selected from the group consisting of polyethylene oxide, polypropylene oxide, polybutylene oxide, and mixtures thereof.

49. The method of claim 47, wherein the halogen containing polyether comprises an epichlorohydrin terminated polyethyleneoxide methyl ether.

50. The method of claim 47, wherein the weight ratio of the hydrophilic reactive polymer to the halogen containing polyether is in the range of from about 1:1 to about 10:1.

51. A method of reducing the water permeability of a well bore, comprising:

introducing into the wellbore an aqueous well treatment fluid comprising a water soluble relative permeability modifier,

wherein the water soluble relative permeability modifier comprises a hydrophilically modified water soluble polymer,

wherein the hydrophilically modified water soluble polymer is a reaction product of a hydrophilic reactive polymer and a hydrophilic compound, and

wherein the hydrophilically modified water soluble polymer is selected from the group consisting of the reaction product of polydimethylaminoethyl methacrylate with epichlorohydrin terminated polyethyleneoxide methyl ether, the reaction product of poly(acrylamide/dimethylaminoethyl methacrylate) with epichlorohydrin terminated polyethyleneoxide methyl ether, the reaction product of polydimethylaminopropyl methacrylamide with epichlorohydrin terminated polyethyleneoxide methyl ether, and the reaction product of poly(acrylamide/dimethylaminopropyl methacrylamide) with epichlorohydrin terminated polyethyleneoxide methyl ether,

thereby reducing the water permeability of the well bore.

52. The method of claim 51, wherein the hydrophilically modified water soluble polymer comprises a polydimethylaminoethyl methacrylate epichlorohydrin terminated polyethyleneoxide methyl ether reaction product having a mole ratio of polydimethylaminoethyl methacrylate to epichlorohydrin terminated polyethyleneoxide methyl ether of 3:1.